CENTRAL VENOUS ACCESS DEVICES (CVAD)

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

All clinical staff who insert CVADs or care for a patient with an CVAD must comply with the NSW MoH Policy Directive Intravascular Access Devices (IVAD) - Infection Prevention & Control [PD2019_040] [1]

- Guidelines on CVAD insertion, care and removal at SCHN
- CVAD Insertion and removal form must be completed
- Post insertion care and maintenance of CVADs can ONLY be performed by accredited staff who have undergone appropriate SCHN education.
- Homecare advice provided and emergency first aid kit must be given to all patients and families with CVAD insitu.

CHANGE SUMMARY

- Blood culture collection – do not use discard blood. Follow Blood Culture Collection guideline.
- No changes to Local Work Procedures and other than blood culture collection, no changes in practice. There are, however, minor wording changes made throughout this Guideline. Links and references updated.
- Amended Information sheets (CVAD Untrimmed Priming Volumes, Dressing and Securement Product guide and CVADs used at SCHN) as some products are no longer used at SCHN.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st December 2023	**Review Period**: 3 years
Team Leader:	CNS2 Vascular Access	**Area/Dept**: Vascular Access

READ ACKNOWLEDGEMENT

- **All staff engaged in the clinical management of patients with a CVAD** must read and acknowledge (sign-off) they have read and understood the SCHN CVAD Practice Guideline and Local CVAD Procedures and the NSW Health Intravascular Access Devices – Infection Prevention & Control Policy Directive (PD2019_040).

Training/Assessment required by Registered Nurses and Enrolled Nurses:

- Complete My Health Learning (HETI) online courses described in Section 1.3
- Attend CVAD Education session including SCHN CVAD PowerPoint presentation and practical and/or observation session with accredited assessor.
- Complete CVAD competencies
- Complete modified accreditation at and every 3 years

Training/Assessment required by medical staff:

- Complete My Health Learning (HETI) online courses described in Section 1.3
- Attend CVAD Education session.
- Complete identified CVAD competencies deemed relevant to the clinical area.
- **Insertion**: Clinicians without prior paediatric experience of CVAD insertion must complete a training program consistent with NSW Ministry of Health Central Line Education and Training Framework. Untrained clinicians must be supervised by supervising Surgeon / Interventional Radiologist or Anaesthetic consultant when inserting a CVAD.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st December 2023	**Review Period**: 3 years
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About this document

Purpose:

The purpose of the Sydney Children's Hospitals Network (SCHN) Central Venous Access Device (CVAD) Practice Guideline is to promote safe management of the devices and prevent harm related to their use. This document reflects the NSW Ministry of Health (MoH) Intravascular Access Device (IVAD) Infection Prevention and Control Policy Directive [PD2019_040] for minimum standards for insertion, management and removal of CVADs. These guidelines should be read in conjunction with SCHN documents:

- Aseptic Non Touch Technique
- Intravenous Fluid and Electrolyte Therapy
- Medication Administration

Central Venous Access Device Management in Neonates in the ICU Environment Scope:

The document outlines the minimum standards to ensure the safe use of vascular access devices and should be used in conjunction with the manufacturer's instructions for use.

This practice guideline is applicable to all patient care settings and patient populations, excluding neonates within the ICU environment, within the SCHN in which devices are inserted, managed or removed. Staff managing neonates should refer to the CVAD Management in Neonates in the ICU Environmental Practice Guideline.

The following devices have been included in these guidelines:

- Tunnelled cuffed and non-cuffed central venous catheter (CVC)
- Non-tunnelled central venous catheter
- Implantable Venous Ports (Port)
- Peripherally inserted central catheter (PICC)
- Midline catheters

This document is intended to be a usable resource to identify the minimum standard in delivering safe care to patients with a CVAD. Not all sections are relevant to all clinicians caring for patients with a CVAD. The minimum requirement is that staff involved in the clinical management of CVADs must read and acknowledge the relevant sections of this document prior to delivering care to a patient with a CVAD. Staff may also refer to relevant sections prior to delivering an identified aspect of care. The guideline is supplemented by procedural documents that provide practical step-by-step instructions on how to perform certain procedures, with links throughout the document.

Individualised plans of care may be relevant to a specific patient or clinical situation. Any deviation from these guidelines must be made in consultation with the patient's attending medical officer and/or Vascular Access CNS2 and the reasons for practice variation must be documented in Vascular Access Management Plan in eMR.

The guidelines are not intended to be a comprehensive resource on CVADs. There are links within to specific training modules and complimentary documents appropriate to the safe management of CVADs.

Glossary

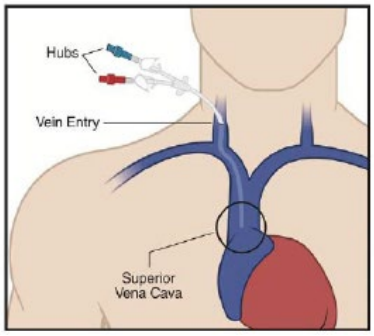
Aseptic Non-Touch Technique (ANTT)	ANTT technique aims to prevent pathogenic organisms, in sufficient quantity to cause infection, from being introduced to susceptible sites by hands, surfaces and equipment. It protects patients during invasive clinical procedures by utilizing infection prevention measures that minimize the presence of micro-organisms.
Key parts **Key sites**	Key-Parts are the critical parts of the procedure equipment that come into direct or indirect contact with active Key-Parts connected to the patient, any liquid infusion or Key-Site. Key-Sites are open wounds, including insertion and puncture sites.
Breaking the closed system	Refers to any instance when the integrity of the CVAD and IV infusion set is compromised or the CVAD catheter hub is exposed.
Closed System	IV administration system with no mechanism for external entry after initial set-up & assembly.
CRBSI	Catheter Related Bloodstream Infection. CRBSI occurs due to pathogenic colonisation of the CVAD.
CVAD	**C**entral **V**enous **A**ccess **D**evice. Overall term that refers to CVC (tunnelled and non-tunnelled) PICC and Port. CVAD is an intravascular device whose catheter tip is situated in the superior vena cava, inferior vena cava or right atrium.
CVC	Central Venous Catheter: Has a skin entry point in the neck, or trunk or groin and whose catheter tip is situated in the superior/inferior vena cava or right atrium. These CVCs can either be classified as tunnelled, non-tunnelled or Cuffed or Uncuffed.
Hub	External end of the CVAD
Intravenous (IV) Infusion Set	An intravenous infusion set refers to the use of a burette, infusion sets and extension tubing.
IVAD/Port	Implantable Venous Access Device (IVAD) or Totally Implantable Device (TID), otherwise more commonly known as Ports or Portacath (type of CVAD). The term “Port” will be used for the remainder of document.
Midline	Medium length venous line for short term use. A Midline is a 5cm or 8cm long vascular catheter that is inserted peripherally into the basilic, cephalic or brachial vein using ultrasound guidance. The tip of the catheter lies in the axillary vein and does not extend beyond the axilla. Midlines can also be inserted into the long saphenous vein at the ankle, but this is less common.
PICC	Peripherally Inserted Central Catheter. Has a skin entry point in the upper arm or lower leg and is advanced through to the central circulation.
Positive Pressure Locking Technique	Refers to a technique that is required during CVAD locking procedures. While instilling the lock solution the operator should clamp the CVAD off while instilling the last 0.5ml of lock solution in the syringe. This creates positive pressure within the CVAD lumen and prevents backflow of blood into the catheter tip and subsequent thrombus formation.
Pulsating Technique	Pulsating technique refers to flushing a CVAD using a pulsing (push-pause-push) action following the administration of medications, collection of blood samples, and prior to connecting IV infusion sets. This creates turbulence in the catheter lumen assisting the prevention of fibrin sheath formation and drug precipitation.
rt-PA / alteplase	**r**ecombinant **t**issue **P**lasminogen **A**ctivator or also known as alteplase
Standard Precautions	Apply to blood and blood products (including dried blood), all body substances, secretions and excretions (excluding sweat) regardless of whether they contain visible blood, non-intact skin and mucous membranes including eyes. Are designed to reduce the risk of transmission of micro-organisms from both recognised and unrecognised sources of infection in health organisations. Involve the use of safe work practices and protective barriers including hand hygiene, appropriate use of gloves, appropriate use of Personal Protective Equipment (PPE) (e.g., gowns & masks) and appropriate device handling.
NAD - Needleless access/ connector device	Luer activated needleless connector or needleless access device. These devices are also known as valves or bungs. NAD will be used for the remainder of the document.
Hand Hygiene	Perform hand hygiene with 60 second hand-wash with 2% chlorhexidine gluconate in 70% alcohol. Dry hands with clean paper towels. Alternatively, using an alcohol-based hand-rub for 30 seconds (until hands are dry) will achieve proper hand antisepsis, as long as hands are not visibly soiled or contaminated with organic materials.

1 Introduction to Central Venous Access Devices (CVADs)

1.1 CVAD types

Refer to CVADs used at SCHN and Insertion Requesting Pathway CHW **OR** Insertion Requesting Pathway SCH. CHW also has an inter-hospital referral pathway for CVAD insertion, designed to be used as a guide on the receiving of referrals, triaging and coordination CVAD insertion transfers to CHW from facilities outside SCHN.

- *Included in the scope of this document*:
  - Tunnelled cuffed Central Venous Catheters (CVC)
  - Tunnelled uncuffed Central Venous Catheter (CVC)
  - Non-tunnelled percutaneously inserted central venous catheter (CVC)
  - Implantable Venous Access Device (Port)
  - Peripherally Inserted Central Catheter (PICC)
  - Midlines
  - Non-tunnelled Vascaths/Gamcaths for use outside a Nephrology or Haematology setting:
    - A non-tunnelled haemodialysis catheter or Vascaths / Gamcaths are inserted for temporary procedures such as the collection of Peripheral Blood Stem Cells (PBSC) or Apheresis.



    - These catheters are uncuffed and non-tunnelled and remain in place for a short duration of therapy, usually for a maximum of 5 days. Due to the short duration of dwell time, the dressing will usually remain intact until catheter removal.
    - These catheters are only for use for these therapeutic procedures but can be accessed for blood collection or infusion by CVAD accredited staff.
    - **1000 units per mL (or greater) heparinised saline is recommended for locking** (high concentration due to large bore size).
    - Patients must remain hospitalised while the catheter is in place
    - For patients with femoral-inserted catheters, it is recommended the patient does not weight bear and where possible not sitting at an angle greater than 45 degrees.
  - Perma-caths used outside Nephrology and Haematology settings are for long term use and can be accessed by CVAD accredited staff under direction of treating team. Patients may go home with these devices in place.
- *Excluded in the scope of this document*:
  - Haemodialysis catheters. Refer to:
    - CHW Haemodialysis and Plasma Exchange: Managing Catheter Access or
    - SCH Vascular Access Catheters: Insertion & Management of Temporary Vascaths

1.2 CVAD Management Support

During hours, all matters related to CVAD management support are escalated to the Vascular Access CNS2 at CHW (page 6763 or mobile 0418 215 740) or SCH (page 44313). For CVAD management support after hours and weekends, escalation occurs via the below pathways.

- **Anaesthetics:** CVC non-tunnelled, PICCs, Midlines and Tunnelled Uncuffed CVCs
- **General Surgery:** Port (IVAD) and Tunnelled Cuffed CVCs

1.3 Other relevant information linked to this document

1.3.1 Local CVAD procedures

- Accessing a CVC/PICC/Midline – Not in Use
- Accessing a Port
- Accessing an Apheresis Port
- Antibiotic Lock to Sterilise CVAD
- Calculating Priming Volume (Dead-Space)
- CVC PICC and Midline Dressing Change
- De-accessing a Port
- De-accessing an Apheresis Port
- Locking a CVC/PICC/Midline
- Removal of a PICC, Tunnelled Uncuffed CVC or non-tunnelled CVC
- Repairing Tunnelled CVC
- Thrombotic Occlusions

1.3.2 CVAD Homecare Guidelines for Parents/Carers

- Central Venous Catheter (CVC) and Peripherally Inserted Central Catheter (PICC) Homecare Guideline
- Port Homecare Guideline

1.3.3 Vascular Access Factsheets for Parents/Carers/Patients

CVAD Factsheets are available on the SCHN internet page:
https://www.schn.health.nsw.gov.au/fact-sheets/category/#cat65

PDF versions are also available:

- Uncuffed tunnelled central venous catheter at home
- Intravenous cannula at home
- Midline at home
- PICC at home
- Cuffed Tunnelled Central Venous Catheter
- Midline

- Peripherally Inserted central catheters (PICCs)
- PICC Lines in Neonates
- Port - Implantable Venous Access Device
- Uncuffed Tunnelled Central Venous Catheter
- Alteplase Information Sheet for Parents

1.3.4 CVAD Intranet page

See: https://intranet.schn.health.nsw.gov.au/clinical/central-venous-access-devices-cvad

- CVAD Information sheets:
  - CVADs used at SCHN
  - Types of add-on Devices used at SCHN
  - CVAD Dressing and Securement Product Guide
  - CVAD – Associated Skin Impairment (CASI) Algorithm
  - Types of Occlusions
  - CVAD Untrimmed Priming Volume
  - Blood Culture Collection – SCHN Poster
- CVAD First Aid Kit for Midlines; for PICC; for Tunnelled Cuffed or Uncuffed CVC
- CVAD Occlusion Management Pathway
- Insertion Requesting Pathway: Randwick
- Insertion Requesting Pathway: Westmead
  - CHW Inter-hospital transfer request for CVAD insertion Pathway and Referral Form
- Venous Access Decision Pathway: Randwick
- Venous Access Decision Pathway: Westmead
- CVAD Procedure videos (in draft)

1.3.5 Other Policies

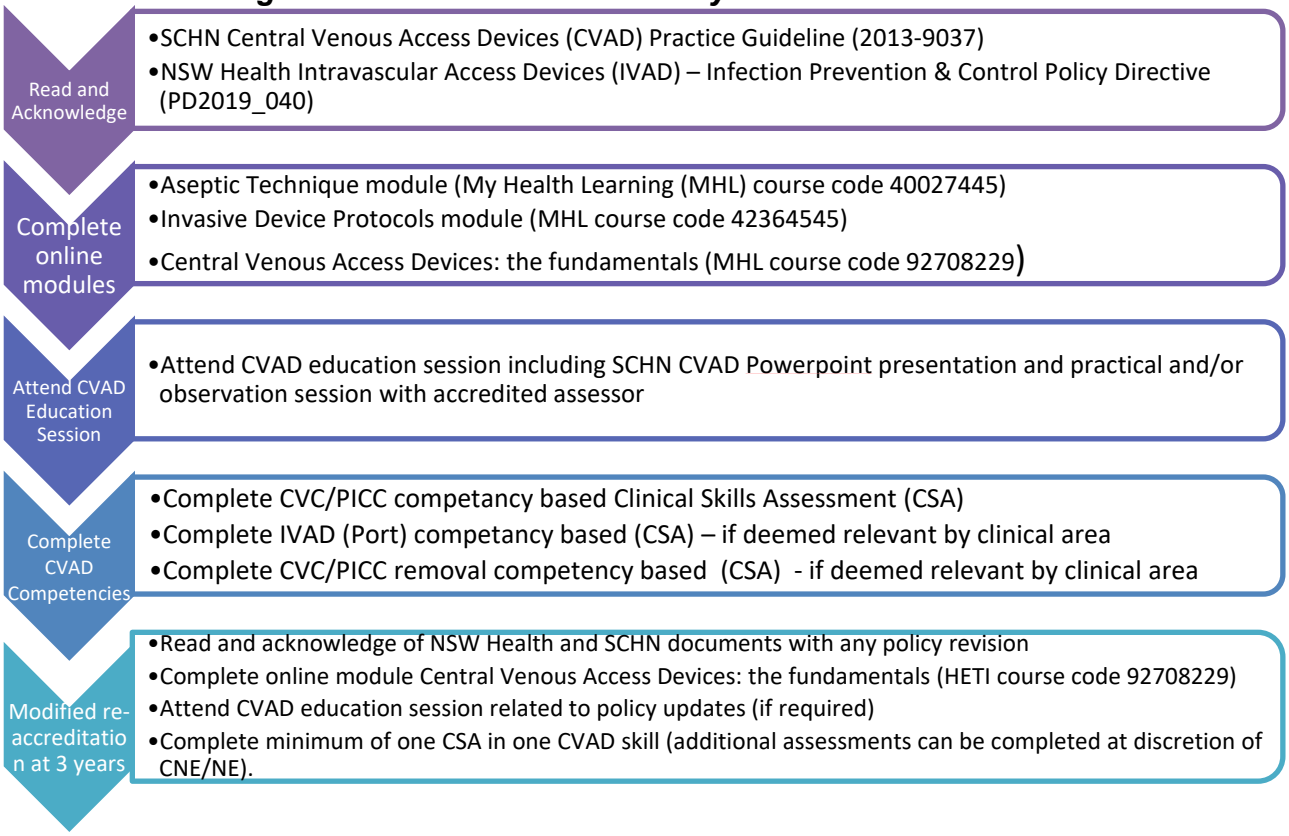
- NSW Health Policy Directive [PD2019_040] Intravascular Access Devices (IVAD) – Infection Prevention and Control
- Aseptic Non Touch Technique Policy
- Intravenous Fluid and Electrolyte Management
- Intravenous Extravasation – Management
- Medication Administration
- Between The Flags (BTF) : Clinical Emergency Response System (CERS) Procedure
- Clinical Incident Management Procedure
- Medication Handling [NSW Health PD2022_032] for labelling requirements
- Hand hygiene Policy
- Consent to Medical and Healthcare Treatment Manual
- Clinical Skills Assessment Framework Procedure

1.4 Staff Education and Training

For more information refer to Section 2.1 in PD2019_040.[1-5]

Note: Post insertion care and maintenance of CVADs can ONLY be performed by accredited staff who have undergone appropriate SCHN education.

1.4.1 Nursing CVAD Accreditation Pathway



CVAD Accreditation Process for Nursing

- Nursing staff may be accredited in CVAD management as deemed appropriate by the clinical area.
- This process encompasses accreditation of all appropriate nursing staff including ENs, RNs, CNEs, NEs, CNSs, CNCs, NPs and NUMs.
- Initial CVAD accreditation involved staff completing the pathway as outlined above.
- CVAD Core Skills (CVC/PICC/Midline) Competency must be completed which includes:
  - Accessing a CVC, PICC or Midline not in use
  - Locking a CVC, PICC or Midline
  - CVC, PICC or Midline dressing change
- CVC/PICC removal and IVAD/Port competency (IVAD/Port access and de-access) are completed if deemed relevant by the individual clinical area.
- Once CVAD Core Skills CSA Competency is obtained, all other clinical procedures are not assessable but must be performed according to practice guideline.
- Triennial (every 3 years) reassessment includes:

- Read and acknowledge any updated relevant policies and attendance at any CVAD update education sessions in relation to policy review
- Assessment of minimum 1x CSA related to CVAD management (excludes CVAD dressing change). Additional assessment can be conducted at discretion of the CNE, NE or NUM.

Registered Nurse and Endorsed Enrolled Nurse Advanced Skill Accreditation

- Following CVAD accreditation, RNs may have the opportunity to obtain advanced skills in tunnelled CVC repair and Apheresis Port Access and De accessing.
- Advanced skill accreditation is not appropriate for all RNs managing CVADs. These skills are to be limited to clinical areas that manage CVADs on a daily basis and can maintain competency in advanced skills.
- NM, NUM, CNE or NE identify and support appropriate nursing staff to obtain CVAD advanced accreditation and initial education and training will be conducted by the Vascular Access CNS2.
- Currently the only advanced skills requiring additional competency and accreditation is tunnelled cuffed CVC repairs and Apheresis Port accessing and De accessing.

Additional

Additional education and training is required for identified RNs responsible for removal of non-tunnelled CVCs, uncuffed tunnelled CVCs and PICCs or IVAD (Port) access accreditation. These additional skills are not advanced skill but are competencies that are undertaken as deemed relevant by the individual clinical area.

1.4.2 Junior Medical Staff Education and Accreditation Pathway

Junior Medical Officer (JMO) orientation will include appropriate education on accessing and managing CVADs and the location of additional resources.

JMOs will be given the opportunity to attend practical CVAD education sessions each term. The practical sessions will be mandatory for Registrars doing terms in surgery, oncology, anaesthetics and ICU where the need to access CVADs is more likely to arise, and optional for other JMOs. An attendance record will be maintained in My Health Learning.

Read and Acknowledge	• SCHN Central Venous Access Devices (CVAD) Practice Guideline (2013-9037) • NSW Health Intravascular Access Devices (IVAD) – Infection Prevention & Control Policy Directive (PD2019_040)
Complete online modules	• Aseptic Technique module (MHL course code 40027445) • Invasive Device Protocols module (MHL course code 42364545) • Central Venous Access Devices: the fundamentals (MHL course code 92708229)
Attend CVAD education session	
Complete CVAD Competencies	• Completed CVC/PICC and IVAD competencies as deemed relevant to clinical area

Note: CVAD procedure videos are in draft and will be located on the SCHN intranet page

1.5 Parent / Carer / Patient education and homecare

For more information refer to Section 2.2 in PD2019_040.[1-5]

When a patient requires a long term CVAD, the parents and patient require education[3, 5] in managing the CVAD in the home environment. The following should occur with parents/ patients/ carers:

- Parents and patient should be shown the type of CVAD that is being inserted prior to insertion and be prepared for what to expect in the post-operative period after insertion including pain, bruising, bleeding and dressings.
- Demonstrations of CVAD cares, such as dressings.
- Must receive both verbal and written education including a copy of the Central Venous Catheter (CVC) and Peripherally Inserted Central Catheter (PICC) Homecare Guideline or Port Homecare Guideline and a copy of the appropriate CVAD factsheet (available on the SCHN internet site).
- Education in the areas of:
    - Issues relating to infection and the importance of early recognition.
    - Risks of dislodgement and damage to the external portion of the tunnelled CVC and the procedure they should follow if these occur. Prior to discharge, each child should receive a CVAD First Aid Kit with the appropriate equipment list. Refer to the relevant CVAD First Aid Kit:
        - CVAD First Aid Kit – Midline
        - CVAD First Aid Kit – PICC
        - CVAD First Aid Kit – Tunnelled Cuffed CVC
        - CVAD First Aid Kit – Tunnelled Uncuffed CVC
    - Risk of haemorrhage and embolism.
    - Any changes to their child's daily routine due to CVAD insertion or additional precautions required. For example, protect CVAD whilst child is playing, bathing or interacting with pets.
- Parents are encouraged to learn how to care for the CVAD at home including completing dressings and, in some instances, parents may take on the responsibility of heparinised saline locking the CVAD. Parents need to be educated on maintaining aseptic technique during procedures prior to permitting parents to take on these responsibilities at home.
- Parents must be observed performing the procedure/s to assess competence prior to discharge, including hand washing and preparation. Document the parent's education and assessment in the patient's medical record.
- Parents are required to troubleshoot adverse events in the home. Their competence in managing adverse events should be assessed prior to discharge.
- RNs should evaluate the parent's/carer's/patient's understanding of CVAD management by asking parents to explain their understanding of CVAD management in the home.

- Parents must know who to contact if they have any concerns.
- All CVAD education must be completed and documented in the patient's medical record prior to patient's discharge.

1.5.1 Bathing, Showering and Swimming with CVADs [7]

CVCs, Midlines and PICCs:

There are potential risks of infection if the area underneath the CVC/Midline/PICC dressing and/or the exit site becomes wet. It is recommended not to submerge the catheter under water, therefore swimming is not advised. If a patient prefers to swim, if clinically applicable, consider inserting a Port as they can be safely submerged.

Therefore:

- **Bathing and showering** is permittedhowever the CVAD and IV infusion set connections MUST NOT be submerged in water or the CVAD site should not be in the direct flow of water. If dressings become wet during bathing/showering, they should be changed immediately post bathing/showering to minimise the risk of infection.
- **Swimming**: Is not routinely recommended with CVC, Midline or PICC.
  Refer to Section 3.10 Dressings.

Ports:

- If the Port is not accessed, patients are able to shower, bathe and swim.
- For inpatients with an accessed Port, care must be taken to ensure no part of the dressing or IV infusion set is submerged in water. In the accidental event of submersion, the dressing needs to be changed and the site re-assessed.

1.6 Documentation

- Refer to Section 2.3 PD2019_040 for minimum documentation requirements.
- Record of Insertion must be completed for each CVAD inserted AND removed.
- Every IVAD insertion, management and removal must be documented at the time of care, or as soon as possible afterwards.

1.6.1 Complications that require ims+ Documentation

Report any of the following in ims+	
Infected CVAD (confirmed)	Pneumothorax
Exit Site Infection, tunnel infection, Port pocket infection	Air Embolism or thromboembolism
Occlusion	Superior Vena Cava Thrombosis
Extravasation of CVAD	Cardiac Arrhythmia or decreased cardiac output
Accidental CVAD removal	Cardiac Tamponade
Repairing a CVAD	Pinch-off Syndrome
Breaking or Splitting of the external component of CVAD	

2 Insertion [1-6]

NSW MoH Policy Directive PD2019_040[1] provides the minimum standards for CVAD insertion. Refer to PD2019_040 for details.

Important information	
Types of CVAD devices	refer to CVAD Information - CVADs used at SCHN
Device selection	• Venous Access Decision Pathway – CHW • Venous Access Decision Pathway – SCH
Requesting a CVAD insertion	• Insertion Requesting Pathway – CHW ○ CHW inter-hospital Requesting Pathway and Referral Form • Insertion Requesting Pathway – SCH
CVAD tip position	**Must** be confirmed before accessing a CVAD
Documentation	Must complete an eMR CVAD Insertion Record form for each insertion and removal.
Antibiotic prophylaxis	Should not be used routinely for the prevention of infection

2.1 Insertion Considerations

Non-tunnelled CVC

- The most commonly used veins for non-tunnelled CVAD insertion are the internal jugular, femoral and subclavian veins.
- If the internal jugular site is used, the right side is favoured as vessel anatomy allows direct access to the superior vena cava.
- When choosing a catheter, use the smallest gauge CVC with the minimum number of lumens.
- Ultrasound is recommended to aid insertion.
- A seldinger technique is used for insertion. The vein is accessed using a needle or cannula and a wire is then fed up into the vein. The CVC is then inserted over the wire.
- Once placed and the tip location confirmed, the line should be secured with a sutureless securement device (or suturing if more appropriate) and covered with a semi-permeable dressing (e.g., Tegaderm IV Advanced)

PICC insertion consideration after placement

- The most commonly used veins for PICC insertion are the basilic and brachial veins in the upper arm. In neonates, the long saphenous vein at the ankle is commonly used.

- A seldinger technique is used for insertion.
- The line should not fill greater than 1/3 of the vessel lumen with the tourniquet down. This will help prevent vein thrombosis.
- In children, PICCs should ideally be cut to size to avoid large amounts of catheter outside the patient.
- The line should be fixed at the insertion site using a sutureless securement device, e.g. Statlock© or Securacath, and covered with a semi-permeable dressing (e.g. Tegaderm IV Advanced©)

Tunnelled cuffed CVAD/Port insertion considerations

- Three veins are typically used
  - Internal jugular vein
  - External jugular vein
  - Subclavian vein
- Two techniques are used for insertion
  - The first is a percutaneous technique, in which ultrasound is used to locate the relevant vein, access is obtained via a Seldinger technique, and the line is tunnelled from an appropriate site.
  - The second option is an open approach in which an incision is made over the vein and the relevant vein is directly exposed with a venotomy.

Tunnelled uncuffed CVC insertion considerations

- These CVCs are inserted by interventional radiologists and some anaesthetists.
- The internal jugular vein is most commonly used.
- A percutaneous technique is used and the line is tunnelled out onto the chest wall.
- The line does not have a cuff and is secured with a sutureless securement device and covered with a semi-permeable dressing.

Midline insertion considerations

- The basilic and brachial veins in the upper arm are the veins of choice.
- Ultrasound must be used to select the vein.
- The line should be inserted into the mid upper arm, so the tip of the line does not extend beyond the axilla.
- The catheter should not fill more than 1/3 of the vein diameter with the tourniquet down and the vein should ideally be at least 3mm in diameter.
- The line should be fixed with a sutureless securement device and covered with a semi-permeable dressing.
- Radiological confirmation of tip position is not required as the tip of the catheter does not extend beyond the axilla.

2.2 Confirmation of CVAD placement

- Do not use the line until the position of its tip is known.
- In the theatre environment, a non-tunnelled CVAD may be placed and used by the anaesthetist before the line is X-rayed. This is up to the discretion of the anaesthetist.
- **Radiological confirmation of the position of the tip must be performed**. This may be done during the procedure using image intensifier (II) or in the interventional suite or afterwards with conventional X-ray.
- The CVAD tip should sit in the SVC or at the SVC-RA junction. The tip should be WITHIN 2 vertebral body heights below carina. Some exceptions do apply e.g. cardiac surgical patients
- Femorally placed lines should have their tips located in the IVC. Either above the renal vessels i.e. tip placement T9-T11 and below the diaphragm or below the renal vessels i.e. below L2. All femoral lines need to be X-rayed to confirm placement.
- **Midlines**: The tip of a midline does not extend beyond the axilla therefore radiological confirmation of the tip position is not required before use.

3 General Management of CVADs [1-6, 17, 18]

3.1 Postoperative Nursing Management and Observation (24hrs post insertion)

Do not use the line until the position of its tip is known and there is confirmation of the CVAD being ready for use.

- There are usually 2 surgical incisions for tunnelled cuffed and un-cuffed CVCs; at the vein entry site (usually the neck) and at the exit site (usually in the chest). For Ports, there are two surgical incisions at the entry site and a second where the chamber is placed.
- Registered and Enrolled Nurses must be aware of potential complications related to CVC insertion. These include:
  - Bleeding
  - Infection
  - Dislodgement/ Tip migration
  - Thrombosis
  - Haematoma formation
  - Arterial injury
  - Nerve injury
  - Pneumothorax
- Temperature, Pulse, Respirations (TPR), Blood Pressure (BP) and surgical site check and pain assessment to be completed on return to ward. Document in patient's medical record.
- An A-G assessment must be attended on return to the ward and at least hourly for 4 hours or as indicated by the patient's clinical condition.
- Observations include:
  - Temperature
  - Pulse
  - Respiratory rate
  - Blood pressure
  - Surgical site check
  - Pain assessment

Note: If there are any changes in the patient's condition postoperatively that relates to the above points, escalate as per Between The Flags (BTF): Clinical Emergency Response System (CERS) Procedure, contact the surgical team/duty anaesthetist responsible for insertion and document in the patient's medical record.

- All entry and exit sites must be checked for:
  - Bleeding (swelling, ooze early after insertion)
  - Infection (heat, redness, swelling, pain); usually 1 – 7 days post insertion.
  - CVC dislodgement (exposed cuffs, increased length of catheter exposed) – call for immediate medical assistance.
- It is recommended dressings applied during insertion of a CVC ideally should be left intact for 7 days. Dressings must be changed if loop not present, heavily soiled or lifting.

- If a dressing needs to be changed within the 7-day period, extra caution should be taken to prevent the dislodgement of the CVAD.
- Prior to discharge, ensure parents have a copy of the appropriate CVAD factsheet and that parent education has been completed. *Ensure that parents are aware of the need to inspect the entry site and exit site regularly* (at least 3 times/day). Ensure that a CVAD First Aid Kit and emergency equipment has been provided including relevant emergency contacts.
- If present, exit site sutures should be removed 1 month post insertion. Exit site sutures should not remain intact for extended periods of time as this increases the risk of infection.

3.2 Daily Nursing Management

- All intravascular devices must be checked at each shift for ongoing CVAD need and promptly removed when no longer required. See **Table 1** for daily assessments.
- The insertion site must be visually inspected by the clinician at least hourly with continuous infusion, at least every eight hours if no infusion.[1]

Table 1 Daily Assessment (Table source – MoH PD2019_040)

Phlebitis	Systemic infection	Infiltration/ extravasation	Other
Erythema Tenderness Swelling Pain Palpable venous cord Purulent discharge	Rigor Fever Tachycardia Hypotension Malaise Nausea / vomiting	Insertion site - Blanched, taut skin - Oedema - IV fluid leakage - Burning/stinging pain Change in infusion flow	Catheter position Integrity of suture Dressing integrity Occlusion / patency Ongoing need for line
For PICCs & Midlines, if limb swelling is suspected, compare the mid-upper limb circumference with the initial value recorded on the CVAD Insertion Record to quantify this. If a significant increase in circumference is confirmed, venous thrombosis should be considered and investigated appropriately.			

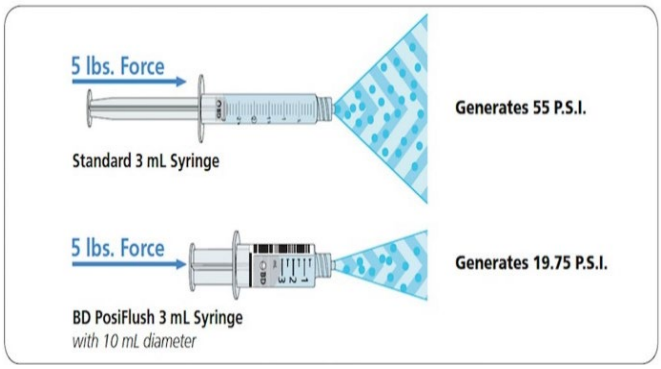
Note: If there any changes in the CVAD assessment, notify the Team Leader or CVAD accredited nursing staff and notify relevant medical officer. Consider seeking assistance from CVAD accredited senior nursing staff or the Vascular Access CNS2.

- **Document observations** in CVAD assessment in eMR each shift under 'CVAD Care' and 'CVAD Lumen Care' in 'Interactive View and I&O'. This includes:
  - Exit site condition
  - Dressing integrity
  - External catheter measurement – for PICCs, Midlines, Uncuffed Tunnelled CVCs, non-tunnelled CVCs
  - Patency assessment

- When appropriate additional documentation includes:
  - Port needle insertion date
  - NAD change
  - IV set change and bag change
  - Lumen locking
- CVAD dislodgement (exposed cuffs, increased length of catheter exposed) – call for immediate medical assistance.
- All procedures related to long term CVAD management should be performed:
  - In close proximity to the patient (i.e. IV infusion sets are to be primed as close to the patient as possible (i.e. in the same location) and/or practicable, and
  - Close to time of connection to CVAD

Note: Minimum syringe size to be used with CVC, Midlines PICCs and Ports is 10mL. This is to reduce the possibility of an over pressurisation effect (this may cause catheter rupture when pressures are in excess of 40psi).

Sodium chloride 0.9% pre-filled syringes are available in volumes smaller than 10mL but the syringe bore is still a 10mL size so these are acceptable for use on a CVAD (e.g. BD Posi Flush)



Refer to Local CVAD procedures:

- Locking a CVC/PICC/Midline
- Accessing a CVC/PICC/Midline – Not in Use
- Accessing a Port
- De-accessing a Port
- Accessing an Apheresis Port
- De-accessing an Apheresis Port

3.3 Needleless Access Device (NAD)[1-7, 23]

- Removal of a NAD must be performed using ANTT.
- Anytime a NAD is removed from the catheter, this is to be discarded and a new sterile NAD should be attached, using appropriate ANTT.
- NADs that are not bonded to the central line should be changed:
  - At least every 7 days (coinciding with administration set changes)
  - Every 96 hours with IV infusion set changes (if connected)
  - At the frequency recommended by the manufacturer
  - If the integrity of the NAD is compromised (e.g. presence of residual blood or visibly soiled)

- When a patient is admitted to hospital, the NAD should be replaced when accessing the CVC
- In the outpatient setting, for patients requiring CVAD access multiple times per week, a risk assessment should be performed to identify an appropriate frequency of NAD changes in accordance with the above criteria.

Refer to CVAD Information - Types of add-on devices used at SCHN for pictures of NADs.

3.4 Intravenous (IV) Infusion Sets

Disconnected IV infusion sets MUST be discarded and NOT reconnected.

IV administration set changes should be done in accordance with Intravenous Fluid Management Practice Guideline and NSW Health Intravascular Access Devices (IVAD) – Infection Prevention and Control Policy Directive [PD2019_040]

Refer to Table 7 in MoH PD2019_040 (pp23) **for frequency of line changes**.

- IV administration sets include both the IV lines and any additional attachments such as needleless injection ports, sideline syringe infusion pumps, three-way stopcocks, multi-flow adaptors and extension tubing that may be added.
- IV administration sets must be attached to the patient so that no tension is applied to the catheter to reduce the risk of dislodgement.
- Ensure all components of the administration system are compatible (including sideline syringe infusion pump or burettes and needleless injection ports) to the devices to minimise leaks and breaks in the system.
- All connections must be luer-lock.
- An extension piece with bleedable valve/s should be placed between the CVC hub and the IV infusion set as the portal for blood collection and administering medications whilst acting to maintain a closed system.

Note: Once CVAD is connected to an IV infusion set, it is referred to as a closed system. This system remains closed for procedures that can be performed through an extension piece with bleedable valves, such as flushing, withdrawing blood and administering medications.

- A continuous system should be maintained as intermittent disconnections of administration sets increase the risk of infection. If disconnected, IV lines must be replaced.
- If a port is to remain accessed, the non-coring port needle should be changed every 7 days.
- The closed system should only be broken for procedures such as changing IV infusion sets, changing NADs, disconnecting IV infusion sets or locking the CVAD.
- The set up and priming of IV infusion sets should be performed in close proximity to the patient and close to time of connection to CVAD.
- When in TKVO mode, CVAD IV infusion sets should infuse through an infusion pump at a minimum volume dependant on the pump type. Minimum amount may vary according to patient age and condition as well as infusion pump device used.

- In general, minimum infusion pump rates are ***approximately***:
  - Volumetric pumps ~ 5 - 10mL/hr
  - Syringe driver ~ 2mL/hr (in neonates)

  Refer to Medication Handling [NSW Health PD2022_032] for labelling requirements.

3.5 Administration of medications

- Policy and guidelines related to the administration of specific medications must also be followed in conjunction with the CVAD guidelines to prevent medication precipitation, particularly with the administration of High-Risk medications e.g. Phenytoin
- Refer to related policies:
  - High Risk Medicines Register Policy
  - Phenytoin Administration Drug Protocol
  - Medication Administration Practice Guideline
  - Intravenous Extravasation – Management Practice Guideline
  - Hazardous Medications – Management and Handling Practice Guideline

3.6 Blood Collection from a CVAD [1-6, 22]

Note: The risk of infection and CVC occlusion increases each time a CVC is accessed. Venepuncture or finger prick sampling should be utilised wherever possible.

Note: The *small diameter* of Midlines and PICCs have an increased likelihood of clot formation. Midlines should not be routinely bled. PICCs and Midlines may be used for blood collection under the direction of the treating requesting Medical Team with consideration for smaller lumen sizes (particularly 3Fr/20 gauge (or less) having a higher risk of occlusion.

- Ensure ANTT is maintained during blood collection
- If IV therapy is being administered:
  - Ensure all alternate lumens and extension tubing is clamped during collection
  - Collection must be performed via a luer lock valve of the extension tubing. Do NOT disconnect IV tubing for the purpose of blood collection

Patient population	Volume	Additional information
General blood collection	3mL	Discard blood must not be used for general blood collection.
Blood cultures	Approx. 3-5mL/bottle For details, see Blood Culture Collection Guideline	Do not use discard. A smaller volume may be indicated depending on clinical situation.
Volume depleted patients	2 x catheter priming volume	Decision in consultation with the treating team or Vascular Access CNS2

- 3mL discard provides sufficient volume to clear a CVAD catheter of any contaminants prior to blood collection.
  - In some instances, twice the catheter volume may be an appropriate discard to reduce blood volume depletion. This should be at the direction of the treating team and/or vascular access CNS2.

Practice Point: Taurolock should be discarded when accessing a CVAD and should not be used for a blood culture sample.

- Blood cultures should be taken using circulating blood.
  - Refer to Blood Culture Collection Guideline or Blood Collection poster for recommended volume for each blood culture bottle. Yield increases with volume up to maximum volume per bottle; however, a smaller volume may be indicated depending on the clinical situation.
- Monitor for possible erroneous results when using sub-optimal volumes.

3.7 Flushing a CVAD

- The technique recommended to remove any substances that could cause occlusion is **pulsating action**.
  - **Pulsating action** refers to flushing a CVAD using a pulsing (push – pause – push) motion following the administration of medications, collection of blood samples or prior to connecting IV infusion sets. This creates turbulence in the catheter lumen assisting with the prevention of fibrin sheath formation, internal lumen thrombosis and drug precipitation.
- Routine flushing of the CVAD must occur:
  - After placement
  - Before and after each fluid infusion or injection
  - After drawing blood
- The minimum volume for a pulsating flush is 10mL of sodium chloride 0.9%; certain viscous medications may require a higher volume. Occasionally, relative to a patient's condition/age the minimum amount may vary, and this should be discussed with patient's medical team and documented.
- The use of prefilled 10mL sodium chloride 0.9% syringe may be utilised for flushing through CVAD and is recommended [4, 5, 8] in reducing the risk of Catheter Related Bloodstream Infection (CRBSI).

3.8 Locking a CVAD [3-6, 14, 18]

- Regardless of lock solution, the most important aspect of locking is the use of a **Positive Pressure Lock Technique**. Maintaining positive pressure inside the catheter lumen discourages backflow of blood into the CVAD and subsequently pooling to form a thrombotic occlusion.
- A NAD must be used when locking a CVAD. Syringe caps or any other caps are not to be used.
- It is recommended that lock solutions are aspirated and discarded when accessing CVADs and not flushed into the patient. PICC and Midline do not require lock solutions to be aspirated if not accessing for blood collection as per treating team.
- CVADs should not be locked more than once a day to minimise manipulation which increases potential risk of infection.

Note: Once locked, clamps on the CVAD should not be moved as this will remove the positive pressure lock that has been created.

Refer to Local CVAD Procedure – Locking a CVC, PICC or Midline for details

3.9 Lock Solutions, volumes and frequency [3 – 6 , 8-13, 18]

Choice of lock solution is at the discretion of the treating team. Consider consulting with the CNS2 Vascular Access for guidance.

Type	Minimum Recommended Lock Frequency	Volume of lock solution	Sodium chloride 0.9%^ *(less than 24hrs)*	Taurolock©* Taurolidine 1.35% + citrate 4% *(greater than 24hrs)*	Heparinised Saline# 10 units/mL *(greater than 24hrs)*
Non-tunnelled percutaneous CVC	CVC not in use up to 7 days	1mL per lumen	✓	X	✓
Midline	not in use up to 7 days	1mL per lumen	✓	X	✓
Tunnelled uncuffed CVC PICC	CVC not in use up to 7 days	1mL per lumen	✓	✓	✓
Tunnelled cuffed CVC	CVC not in use up to 7 days	2mL per lumen	✓	✓	✓
Port/IVAD	Port not in use up to 1 month	3mL	✓	✓	✓

^ *Sodium chloride 0.9% is considered appropriate for locking any CVAD. In patients with long-term CVADs or situations where the CVAD will be locked for greater than 24hrs, alternative lock solutions may be considered.*

*****Taurolock© (taurolidine-citrate) is an antimicrobial and anticoagulant lock solution that has been shown to exhibit antibacterial and antifungal properties. Taurolock© has shown to minimise potential Catheter Related Blood Stream Infections (CRBSI) in some paediatric populations.*

#*Heparinised Saline is used as an anticoagulant lock solution in reducing the risk of thrombotic occlusion.*

Regardless of the solution utilised the most important aspect to maintaining catheter patency is the techniques used in flushing and locking CVADs.

CVAD accredited nurses are able to order Standing Order Heparinised Saline (10 units/mL), Nurse Initiated Taurolock (taurolidine 1.35% + citrate 4%) and sodium chloride 0.9% locks.

Prescribing of CVAD lock solutions by nursing staff should be completed in accordance with Taurolock Nurse Initiated Medication and Heparinised Saline Standing Order protocols using the 'CVAD Management – Nurse Initiated' PowerPlan in eMR.

Note: EENs can be CVAD accredited but are not endorsed to order CVAD lock solutions.

3.10 Dressings [2 – 6, 17, 18, 20, 21]

- Use a sterile, transparent semi-permeable dressing to protect the insertion site from contamination. Allow continuous observation of the site and to stabilise and secure the device.
- When the patient is diaphoretic or has excessive bleeding or oozing from the site, use sterile gauze secured with a sterile transparent, semi-permeable dressing until this is resolved.
- The exit site should be cleaned with 2% chlorhexidine gluconate in 70% alcohol swab stick (for infants and children greater than 2 months corrected age).
    - Note: Infants up to 2 months corrected age, use 0.1% aqueous chlorhexidine and refer to CVAD Management in Neonates in the ICU Environment for details.
- Follow CVAD Information – Associated Skin Impairment (CASI) Algorithm for alternative solutions when ruling out irritation to skin. Consider only changing one product at a time to rule out cause of irritation. Consult Vascular Access CNS2 or Consultant if CASI is identified for advice on further management and alternative dressings.
- Consider the use of a barrier film in the prevention of Medical Adhesive-Related Skin Injury (MARSI).
- The external portion including the Bi furcation of the tunnelled cuffed CVC should contain a loop or 'S' shape, underneath the transparent dressing to assist in preventing the catheter from being accidentally pulled out.
- If dressing removal aid products are used they should be removed from the skin with 0.9% sodium chloride and site dried prior to skin cleansing to ensure all product is removed from the skin. If left under dressing this can cause skin irritation.

Note: Chlorhexidine should not come into contact with sodium chloride 0.9%, as precipitation will occur, leading to the inactivation of the chlorhexidine. If using sodium chloride 0.9% to clean the skin, ensure it is dry prior to applying the chlorhexidine.

Dressing Change Intervals (adapted from Table 6 MoH PD2019_040)

Dressing type	Replacement intervals
Transparent, semi-permeable, self-adhesive polyurethane	Every 7 days or sooner if the dressing is no longer intact, evidence of inflammation or moist
Dry dressing (gauze)	Every 24 – 48 hrs or whenever loose, soiled or moist

Refer to Local CVAD Procedure – CVC, PICC and Midline Dressing Change for details.

3.11 Securement Devices

- The use of securement devices on CVADs is recommended to minimise the risk of catheter migration or dislodgement resulting in catheter failure and premature removal.
- Securement devices should provide adequate securement, allow the exit site to be easily visible and support the catheter without obstruction.
- The use of exit site suturing may still occur; however this is not recommended due to the increased risk of supporting growth of biofilm leading to an increased risk of development of catheter related bloodstream infection (CRBSI).
- It is recommended practice that securement devices are assessed with each dressing change. If the securement device is not overly soiled, causing skin irritation, lifting away from the skin, not providing adequate catheter securement or obstructing the catheter, the device does not require changing with each dressing change. Assess risk of dislodgement and use clinical judgement based on individual patient assessment.
- It is recommended practice to measure any external catheter length pre and post dressing and securement device changes to identify any catheter migration.
- Subcutaneous securement devices (e.g. Securacath ©) are placed on insertion and remain insitu until catheter removal.

Refer to CVAD Information - Dressing and Securement Product Guide for more information.

3.12 Device Removal

Refer to Local CVAD Procedure – Removal of PICC, Tunnelled-uncuffed or non-Tunnelled CVC.

- Midline removal is the same procedure as peripheral line removal; that is, pull line out and apply pressure. Midline removal does not require a competency or same precautions as PICC removal.
- Port and tunnelled cuffed CVADs are only to be removed by a Medical Officer.
- Devices should be removed based on the following clinical indications:
  - The catheter is no longer required
  - Evidence of systemic infection
  - Damaged catheter
  - Evidence of local infection (redness, swelling, oozing or pain at exit site
  - Persistent catheter occlusion
  - Confirmation of thrombosis
- Device removal must be documented in the CVAD Removal Record (in eMR).

Tunnelled cuffed central venous catheter (CVC) removal in a ward setting

- Tunnelled cuffed central venous catheters (CVCs) may be removed on the ward at the discretion of the General Surgery or Interventional Radiology (CHW only) teams if deemed clinically appropriate for devices inserted which do not yet have established tissue ingrowth around the cuff which would usually require surgical removal. Removal of tunnelled cuffed central venous catheters on the ward should be discussed with the treating team prior to performing CVC removal in a ward setting.
- Any tunnelled cuffed CVC removal attended on the ward must be conducted by the General Surgery or Interventional Radiology (CHW only) teams.
- Any tunnelled CVCs removed in a ward setting must not be cut during device removal.
- Any local anaesthetic and procedural sedation used during a tunnelled cuffed CVC removal procedure must be administered in line with the Procedural Sedation (Paediatric Ward Clinic & Imaging Areas) Practice Guideline and the Sucrose: Management of Short Duration Procedural Pain in Infants Practice Guideline.
- Procedure monitoring, including a full set of observations are to be attended prior to the procedure, on completion and 30 minutes post procedure and should be followed as outlined in the SCHN Removal of a PICC, Tunnelled Uncuffed CVC or non-tunnelled CVC Local CVAD Procedure.
- Once the tunnelled cuffed CVC is removed, post removal monitoring is conducted in line with the SCHN Removal of a PICC, Tunnelled Uncuffed CVC or non-tunnelled CVC Local CVAD Procedure.
- If there is any resistance or procedural difficulty encountered on removal of a tunnelled cuffed CVC on the ward, the procedure should be abandoned and a plan made for it to be removed under general anaesthetic.
- CVAD Removal Record documentation must be completed by the proceduralist as required for all CVAD removal procedures.

4 Complications

There are many potential complications with the use of a CVAD. These complications can be potentially life threatening.

4.1 Infections associated with CVAD

Infection is the most common life-threatening complication of CVADs. Limiting the frequency of access to the device to essential procedures only, is vital in attempting to decrease the risk of infection.

- CVAD infections can occur due to contamination by:
  - Skin flora on insertion
  - Skin bacteria migration down the catheter
  - Bacteria transfer through the hub during manipulation
  - Transient bacteraemia from translocated organisms from other parts of the body (e.g. mouth, gastrointestinal tract or skin)
- The types of CVAD-related infections are:
  - Colonisation of the CVAD
  - Exit-site infection
  - Pocket infection (Port) / Tunnel infection (CVC)

Catheter removal is recommended for catheter related blood stream infection (CRBSI) due to *S. aureus* and Candida species, as well as treatment with systemic antibiotics. Catheter retention with hydrochloric acid locks is NOT recommended for these organisms, unless there are unusual extenuating circumstances (e.g., no alternative catheter insertion site).

Note: Antibiotic locks are not to be used routinely to prevent infections (i.e. for prophylaxis), but can be utilised to sterilise confirmed CVAD infections in conjunction with systemic antibiotic therapy. Refer to Section 4.1.3 Use of Antibiotic Locks to sterilise CVADs or contact Infectious Diseases. **ID Consult is required for all antibiotic locks**.

4.1.1 Catheter-Related Blood Stream Infection (CRBSI)

If a patient has a CVAD insitu and develops a fever without any obvious signs of infection, a CRBSI must be considered and remain as the key source of infection until proven otherwise. If confirmed infection, **complete an ims+** report.

CRBSI occurs due to pathogenic colonisation of the CVAD. If a CRBSI is considered, perform the following:

1. Take peripheral blood cultures where possible to assist in identifying colonisation of catheter vs. sepsis
2. Take blood cultures from CVAD (all lumens). Label blood cultures with each lumen.
3. Start IV antibiotics. Each IV antibiotic dose should be administered through alternate lumens of the CVC, therefore all lumens of the CVC are connected to IV infusion sets. In cases where continuous infusions of chemotherapy or inotropes are in progress, alternating each dose of antibiotic may not be possible. Similarly, in cases where parenteral nutrition (PN) is in progress consider stopping PN for a period of time or discuss compatibility of antibiotics with Pharmacy.
4. Notify consultant. Discuss CVAD removal.
5. If in doubt treat as infected CVAD for 48-72 hours until blood culture results are available.

4.1.2 Definition of Catheter-Related Bloodstream infection (CRBSI) [4, 5, 26]

<table>
<tr><th colspan="2">NSW Health definition of Catheter Related Bloodstream Infection (CRBSI) for adults and paediatrics</th></tr>
<tr><td colspan="2">The bloodstream event must meet one of the following criteria:
(Criteria 1 and 2 may be used for patients of any age, including patients < 1 year of age):</td></tr>
<tr><td>Criterion 1:
Patient has a recognised pathogen cultured from one or more blood cultures and organism cultured from blood is not related to an infection at another site. (See Notes 1 and 2 below.)</td><td rowspan="2">Criterion 3:
Patient < 1 year of age has at least one of the following signs or symptoms:
■ fever (>38ºC, rectal);
■ hypothermia (<37ºC, rectal);
■ apnoea;
■ or bradycardia and displays:
■ signs and symptoms of infection and positive laboratory results are not related to an infection at another site and common skin contaminant is cultured from two or more blood cultures drawn on separate occasions. (See Notes 3, 4 and 5 below)</td></tr>
<tr><td>Criterion 2:
Patient has at least one of the following signs or symptoms:
■ fever (>38ºC); ■ chills; ■ or hypotension; and displays:
■ signs and symptoms of infection and positive laboratory results are not related to an infection at another site and common skin contaminant is cultured from two or more blood cultures drawn on separate occasions. (See Notes 3 and 4 below.)</td></tr>
<tr><td colspan="2">Notes:
1 In criterion 1, the phrase “one or more blood cultures” means that at least one bottle from a blood draw is reported by the laboratory as having grown organisms (i.e., is a positive blood culture).
2 In criterion 1, the term “recognised pathogen” does not include organisms considered common skin contaminants (see criteria 2 and 3 for a list of common skin contaminants). A few of the recognised pathogens are S. aureus, Enterococcus spp., E. coli, Pseudomonas spp., Klebsiella spp., Candida spp., etc.
3 In criteria 2 and 3, the phrase “two or more blood cultures drawn on separate occasions” means 1) that blood from at least two blood draws were collected within two days of each other (e.g., blood draws on Monday and Tuesday or Monday and Wednesday would be acceptable for blood cultures drawn on separate occasions, but blood draws on Monday and Thursday would be too far apart in time to meet this criterion), and 2) that at least one bottle from each blood draw is reported by the laboratory as having grown the same common skin contaminant organism (i.e., is a positive blood culture). (See Note 4 for determining sameness of organisms.)
Examples of common skin contaminants include diphtheroids [Corynebacterium spp.], Bacillus [not B. anthracis] spp., Propionibacterium spp., coagulase-negative staphylococci [including S. epidermidis], viridans group streptococci, Aerococcus spp., Micrococcus spp.
4 There are several issues to consider when determining sameness of organisms. Refer to Table 3 (page 6-7) in the NSW Heath Healthcare Associated Infection: Clinical Indicator Manual for more information
5 For patients < 1 year of age, the following temperature equivalents for fever and hypothermia may be used: Fever: 38°C tympanic/temporal artery = 37°C oral = 36°C axillary Hypothermia: 37°C tympanic/temporal artery = 36°C oral = 35°C axillary.</td></tr>
</table>

4.1.3 Use of Antibiotic Locks to Sterilise an Infected CVAD [5, 24]

Notes:

1. Antibiotic locks may be used to sterilise an infected CVAD, however, antibiotic prophylaxis is NOT recommended to prevent CRBSIs.

2. If salvage of the catheter is the primary goal, antibiotic lock therapy is the first line of treatment.

3. Antibiotic lock therapy MUST be discussed with the Infectious Diseases (ID) team and follow local Antimicrobial Stewardship policy.

4. Other catheter salvage techniques including the use of hydrochloric acid (HCl) must only be used in accordance with local work practice. (CHW Haematology Guideline)

Consultation with the ID team is essential, as effectiveness of treatment is assessed by clinical and microbiological criteria.

Refer to Local CVAD Procedure – Antibiotic Lock Therapy to Sterilise CVAD for details

Refer to Local CVAD Procedure – Calculating Priming Volume and CVAD Information sheet - Untrimmed Priming Volume.

4.2 Occluded CVAD [3 - 6, 14 – 18]

- There are different types of occlusions. Refer to CVAD Information - Types of Occlusions.
- The formation of thrombotic occlusions presents a major risk to patients with a CVAD. Preventing occlusions is fundamental to CVAD cares, with the most important aspects being positive pressure locks and flushing with pulsating action.
- Early recognition and timely management of occlusions is essential to maintaining functionality, preventing infection and overall longevity of the CVAD.
- Refer to CVAD Information - CVAD Occluded Management Pathway for occlusion assessment and management.

DO NOT USE UNDUE force to unblock a CVAD.

Blocked CVADs should always be dealt with as soon as possible and not left without treatment.

4.2.1 Clearing a Thrombotic Occlusion from CVADs

Refer to Local CVAD Procedure – Thrombotic Occlusions

- Alteplase (rt-PA – recombinant tissue Plasminogen Activator) is a fibrinolytic drug used to manage thrombotic occlusions.
- Alteplase is NOT to be used in attempt to resolve occlusions secondary to chemical precipitate or mechanical occlusions.
- Consider risks and benefits of attempting CVAD salvage with alteplase over CVAD removal.
- Alteplase is most effective in clearing a thrombus of recent origin, therefore treatment should not be delayed.
- Consider full blood count and coagulation profile if known haematological disorder or concerns related to haemorrhage risk. Otherwise, routine baseline blood tests prior to administration are not required.

Alteplase administration

Concentration	1mg/mL
Volume to instil	Maximum standard dose is: • Patient less than 30kg = 1.5 mL • Patient more than 30kg = 2 mL Alternatively, use volume equal to the 110% internal volume of the lumen if known.
Dwell time	2 – 4 hours (standard) Consider 24 – 72 hours for fibrin sheath or mural thrombus
Instillations	Maximum 2 instillations in 24 hours (seek specialist advice)

4.3 Other Possible CVAD complications

Problem	Symptoms / Signs	Causes	Management
Bleeding	Insertion / Exit site bleeding Subcutaneous tunnel bleeding	Delayed haemostasis at catheter exit site, venous insertion site and/or subcutaneous pocket (Ports)	Apply pressure dressing Notify inserting team (Surgical, Anaesthetics, Interventional Radiology) Check coags and full blood count
Pneumothorax	Shortness of breath – shortly after insertion Decreased breath sounds Chest pain cyanosis	Thoracic cavity puncture during subclavian or internal jugular insertion	Confirm with Chest X-Ray Seek surgical and/or cardiothoracic consultation Insert intercostal drain
Septic showers	Fever Hypotension post access, Tachycardia, decrease in LOC, diaphoresis and rigors.	Accessing CVAD and flushing pathogens into patient's circulation, intraluminal infection	• ***Urgent medical review – call Rapid Response*** • Blood cultures, commence IVABs • Consider stop using CVAD for administration of fluid and antibiotics. • Fluid resuscitation • Cardiovascular monitoring • PICU review as required • If loss of cardiac output – dial emergency number • Consult Paediatric Sepsis Pathway
Air Embolism or thromboembolism	Shortness of breath Cyanosis Tachypnoea Hypotension Cardiovascular collapse	CVC being open and unclamped, without syringe attached. Air drawn in during inspiration. Thrombus attached to catheter.	• ***Urgent*** action - Clamp catheter • Call Rapid Response • Apply oxygen • Place patient head down in the Trendelenburg position • Investigate causes • Consult cardiologist urgently
Breaking or Splitting of the external component of CVAD	Leakage of fluid or blood onto dressing and/or skin. Leakage of blood or fluid from external catheter	Accidental damage	• Clamp CVC with atraumatic clamps between exit site and site of leak. • Wrap the CVC in sterile gauze and notify surgical registrar, accredited nursing staff or Vascular Access CNS2 to repair lumen (only tunnelled cuffed CVCs). • Identify the type and size of tunnelled CVC to notify repairer. This is found on the CVC bifurcation. • Collect blood culture only if indicated.
Exit Site Infection, tunnel infection, Port pocket infection	Fever Erythema swelling Pain Tracking Exudate	Subcutaneous migration of pathogens from exit site, inadequate skin cleansing practices	• Swab for microbiology • Oral or IV antibiotics – Seek ID advice • Consider increasing frequency of dressings • Consider CVC removal if unable to control infection Long-term salvage of infected CVC is unlikely due to bacterial persistence in the face of a foreign body. Short term suppression may sometimes be achieved, but ultimately CVC removal is usually necessary.

Extravasation of CVAD	Local oedema. Redness. Localised burning or pain. Fluid leakage Swelling along tunnel or neck Localised pain on infusion	Dislodgment of Port needle Catheter tip migration (intravascular or extravascular) Catheter rupture	• Stop infusion immediately • Notify medical officer • Identify type of fluid infusing to obtain procedure for extravasation of drug, consult with Pharmacy • In Ports, ensure needle is correctly sited, if not consider re-siting. Do not wait for topical anaesthesia • Withdraw residual drug
Superior Vena Cava Thrombosis	Shoulder or retrosternal pain. Facial or trunk oedema - prominent neck veins. Difficulty in aspirating or flushing CVAD.	Mechanical trauma to vein. Infection. High osmolality infusate. Proximal placement of CVAD. Previous multiple CVAD insertions Large catheter in small vein. Hypercoagulation states. History of DVT Recent surgery and/or trauma	• Monitor vital signs • Possible fibrinolytic and anticoagulant therapy • Consider catheter exchange or removal • Consider radiological investigation (Doppler ultrasound / line-o-gram)
Cardiac Arrhythmia Decreased cardiac output	Pulse rate change or ECG rhythm change. Depending upon the rhythm, there may be hemodynamic instability and signs of shock.	Mal-positioned catheter tip within right atrium or ventricle. Arrhythmia most often occurs during insertion however can occur at any time if the CVAD tip is located within the heart.	• Notify team who inserted CVAD • ECG monitoring • Attend formal ECG If there is an unstable arrhythmia, call **emergency number** and commence APLS algorithm prior to repositioning. Treat decreased cardiac output and arrhythmia. As above plus review medications ordered for patient.
Cardiac Tamponade *Potentially fatal complication of CVC insertion*.	Tachycardia, diminished pulses, pulsus paradoxus, hypotension, pallor, cool extremities, clamminess and eventually altered level of consciousness. Jugular venous distension, increased CVP. The heart sounds may be muffled. A CXR may show an enlarged cardiac shadow.	Occurs during insertion due to guidewire or catheter perforation. Can be late complication due to erosion of CVC into pericardial space when it abuts a vessel or cardiac chamber wall (usually the right atrium).	Administration of fluid, which is a common emergency treatment for evolving tamponade, may exacerbate the problem if given via the offending CVAD. If required, commence APLS algorithm and call Rapid Response. This is a **medical emergency,** and the pericardial collection usually needs to be drained using ultrasound guidance.
Pinch-off Syndrome	Inability to withdraw or infuse substances. This may improve with repositioning of the patient.	Compression of the catheter between the clavicle and the first rib, usually in CVADs inserted in the subclavian vein	Reposition patient Chest x-ray to confirm position and exclude catheter tip migration.
Phlebitis	Redness, pain, warmth, swelling, ooze, irritation, skin breakdown at CVAD exit site	Skin reaction to CVAD material, skin cleansing solutions, securement device material or dressing material.	Assess site regularly as part of CVAD observations and try to identify cause of irritation e.g. catheter material, dressing, skin cleansing solution. If ooze is present at exit site, consider skin swab and/or scraping. Seek advice from senior nursing

			staff or Vascular Access CNS2 and/or Dermatology.
Nerve Injury	Respiratory difficulty, unusual pain or sensation (e.g. tingling, burning, numbness)	Nerve damage on insertion	• Stop infusion • Medical and/or surgical review

4.4 Accidental Removal of a CVAD

- If a tunnelled cuffed and un-cuffed CVC is accidentally removed, **apply firm pressure to both the catheter entry site in the neck vein and the external exit site in the chest** regardless of how long the tunnelled CVC has been insitu. Do not release pressure until reviewed by medical team. Severe bleeding can often be controlled by pressure and sitting the patient up to lower the venous pressure.
- Contact clinical team **immediately**.
- Monitor vital signs and estimate blood loss if any.
- If an un-cuffed tunnelled and non-tunnelled CVC, PICC or Midline is accidentally removed, it is important to establish whether ongoing therapy can be provided with a peripheral cannula alone or whether there is a need to re-site the CVAD. If this is the case for a child outside the ICU, the child should be fasted immediately and contact **Vascular Access CNS2** during hours or Anaesthetics/General Surgery after hours (usual escalation pathways).
- Accidental removal of a CVAD must be documented in the CVAD Removal Form (eMR)

4.5 Repairing Tunnelled cuffed CVC [19]

In the event that a silicone tunnelled CVC splits, snaps or cracks a repair of the tunnelled CVC may be possible. Tunnelled CVC repairs are limited to damaged external portions of the CVC. There **must be at least 3 – 5cm** of undamaged lumen remaining external to the exit site.

Contact CVAD accredited senior nursing staff or the Vascular Access CNS2 for review.

Note: If the external portion of a tunnelled CVC splits, snaps or is cracked, **immediately** clamp the lumen proximal to the site of damage on the tunnelled CVC, this must remain clamped during the repair. Cover split with sterile gauze prior to repair.

Instruct the child and family not to remove the clamp.

If a patient presents to Emergency Department with a tunnelled CVC needing repair, the patient should be admitted until the repair is completed.

- Repairing tunnelled CVCs is an **advanced nursing skill** and will be limited to areas that regularly care for tunnelled CVCs. Identified staff in Oncology and intensive care services at CHW and SCH; CNS Vascular Access [both sites] and the CNC Gastroenterology [SCH] are permitted to repair tunnelled CVCs.
- Surgical Registrars: The surgical team is responsible for repair of CVC if there is no other appropriately accredited staff.
- The repair of tunnelled CVC is a Surgical ANTT procedure due to the increased risk of introducing micro-organisms into the lumens of the CVC while performing the repair.

Refer to Local CVAD Procedure – Repairing Tunnelled Cuffed CVC

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